Studying Sea Level Rise and Coastal Forests with Dendrochronology

Stephanie Stotts, Ph.D.

Lihoshimar Gonzalez

IIA EPS-1301765

NNX13AB30A

What we know

- Tidal forested freshwater wetland response to sea level rise
  - Very little
  - Ecotonal position makes them sensitive to sea level rise (Whigham et al. 2009)
  - Forest communities being converted to marsh (Craft et al. 2009)
  - Tree stress can cause changes in the net N and P mineralization, thus impacting eutrophication (Noe et al. 2013)

What we know

- Tidal forested freshwater wetland response to sea level rise
  - Very little
  - Ecotonal position makes them sensitive to sea level rise (Whigham et al. 2009)
  - Forest communities being converted to marsh (Craft et al. 2009)
  - Tree stress can cause changes in the net N and P mineralization, thus impacting eutrophication (Noe et al. 2013)

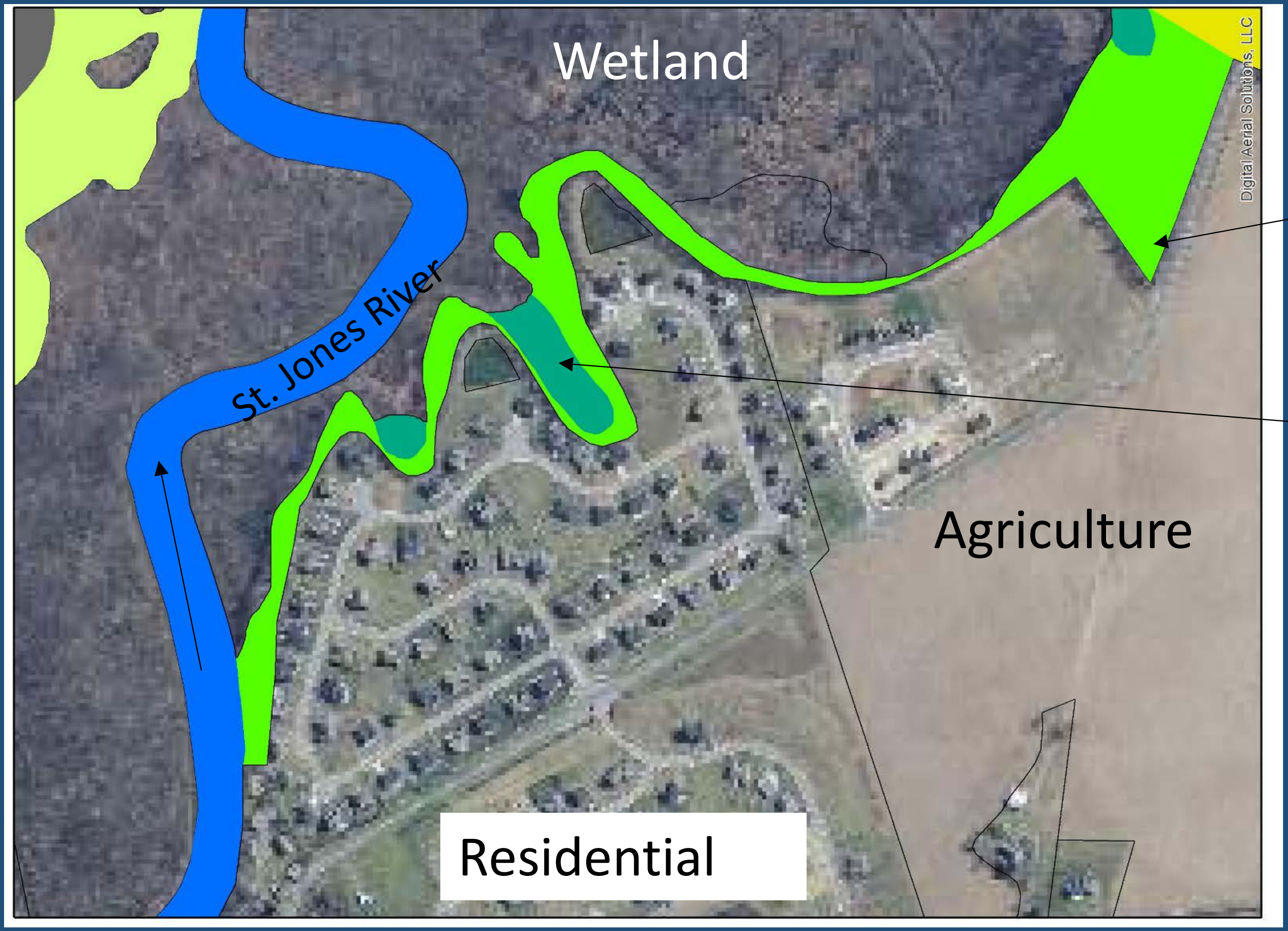
What we know

- Tidal forested freshwater wetland response to sea level rise
  - Very little
  - Ecotonal position makes them sensitive to sea level rise (Whigham et al. 2009)
  - Forest communities being converted to marsh (Craft et al. 2009)
  - Tree stress can cause changes in the net N and P mineralization, thus impacting eutrophication (Noe et al. 2013)

What we know

- Tidal forested freshwater wetland response to sea level rise
  - Very little
  - Ecotonal position makes them sensitive to sea level rise (Whigham et al. 2009)
  - Forest communities being converted to marsh (Craft et al. 2009)
  - Tree stress can cause changes in the net N and P mineralization, thus impacting eutrophication (Noe et al. 2013)

Why Should We Care?



Deciduous Forest

Forested Wetland

Research Questions

1. Can we use dendrochronology and coastal forests as a proxy for sea level rise?

2. Can we learn about coastal forest response to sea level rise?

3. Can we learn about storm frequency and marsh inundation from the tree ring record?

*very few studies with tree rings in these communities

Research Questions

1. Can we use dendrochronology and coastal forests as a proxy for sea level rise?

2. Can we learn about coastal forest response to sea level rise?

3. Can we learn about storm frequency and marsh inundation from the tree ring record?

*very few studies with tree rings in these communities

Research Questions

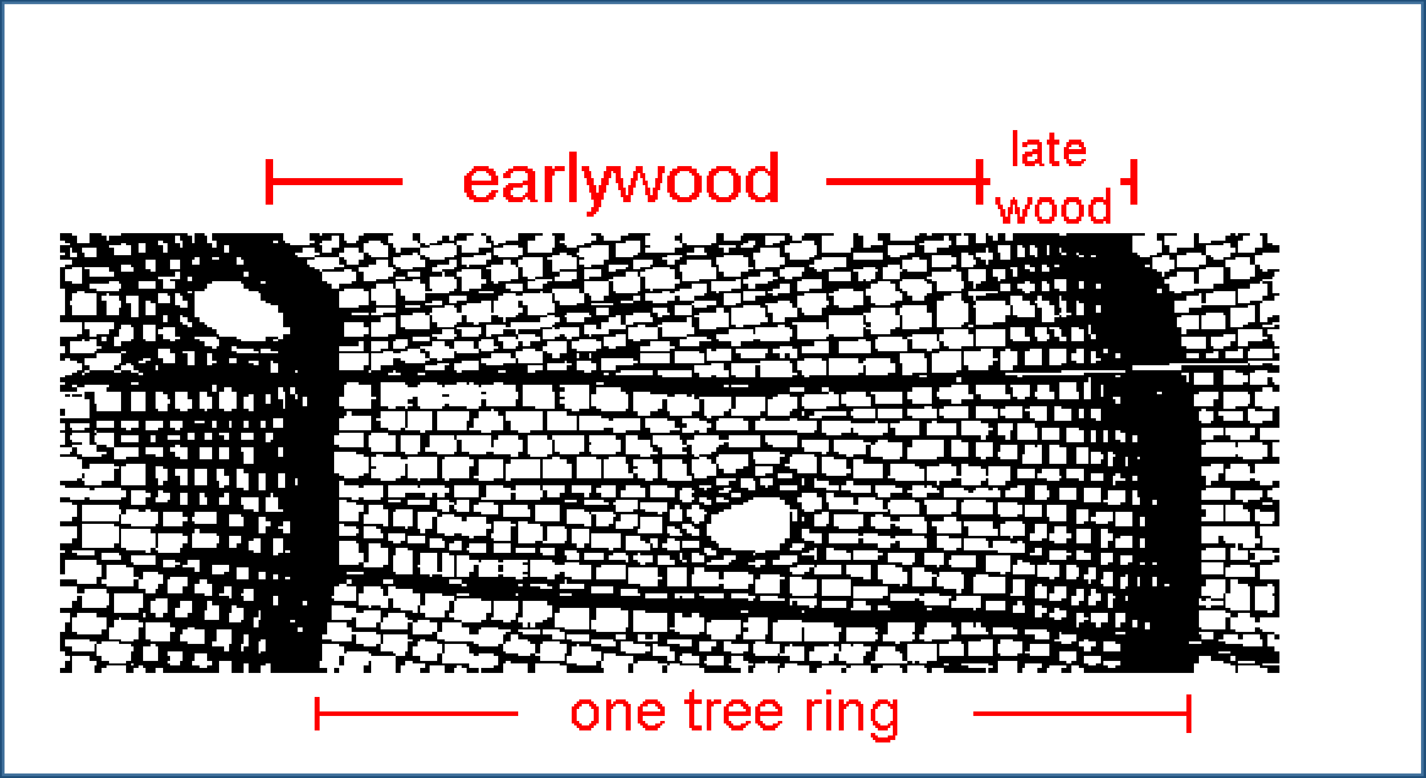
1. Can we use dendrochronology and coastal forests as a proxy for sea level rise?

2. Can we learn about coastal forest response to sea level rise?

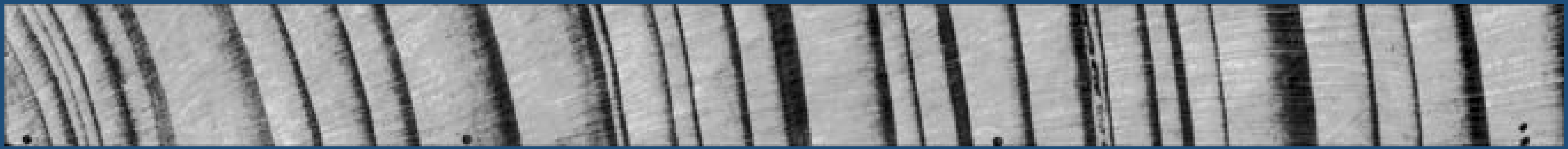
3. Can we learn about storm frequency and marsh inundation from the tree ring record?

*very few studies with tree rings in these communities

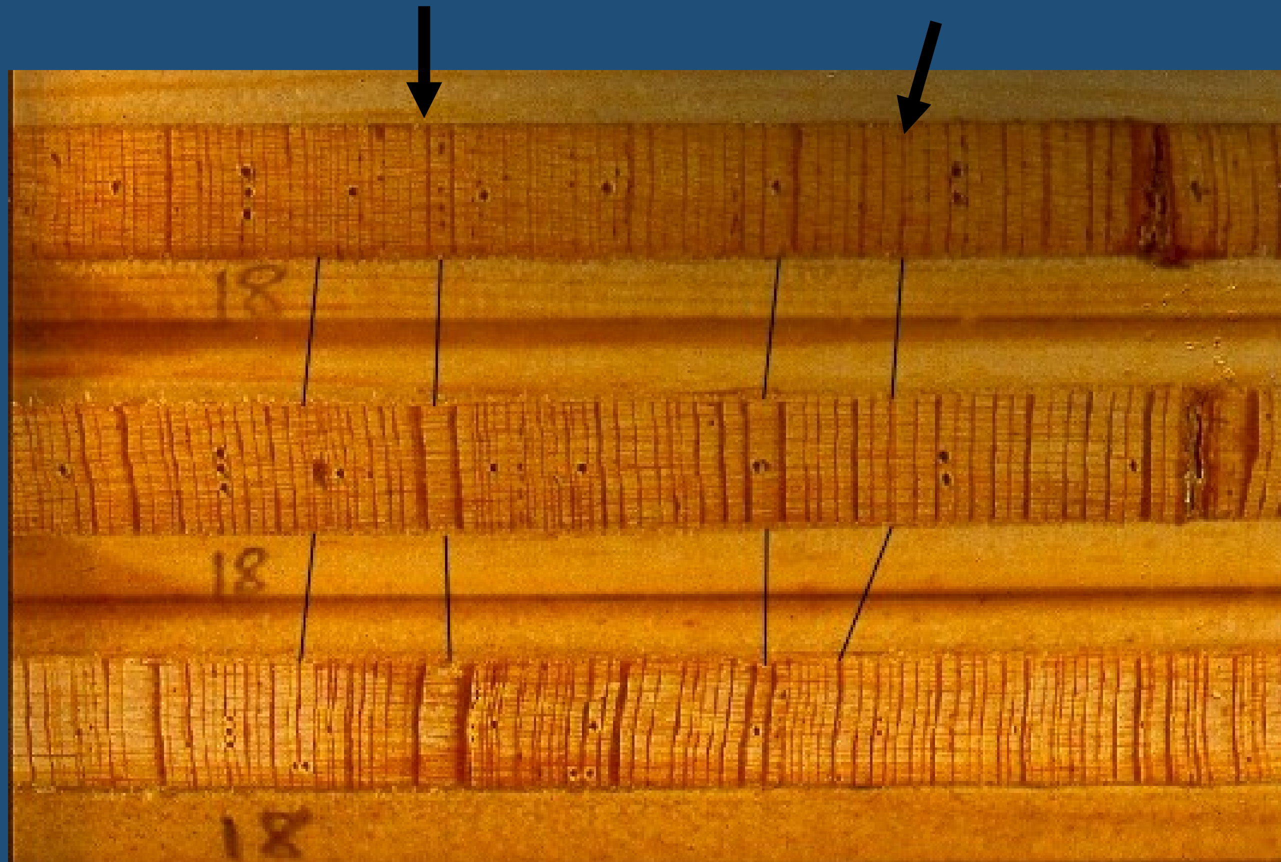
Annual Tree Rings (cross-section view)



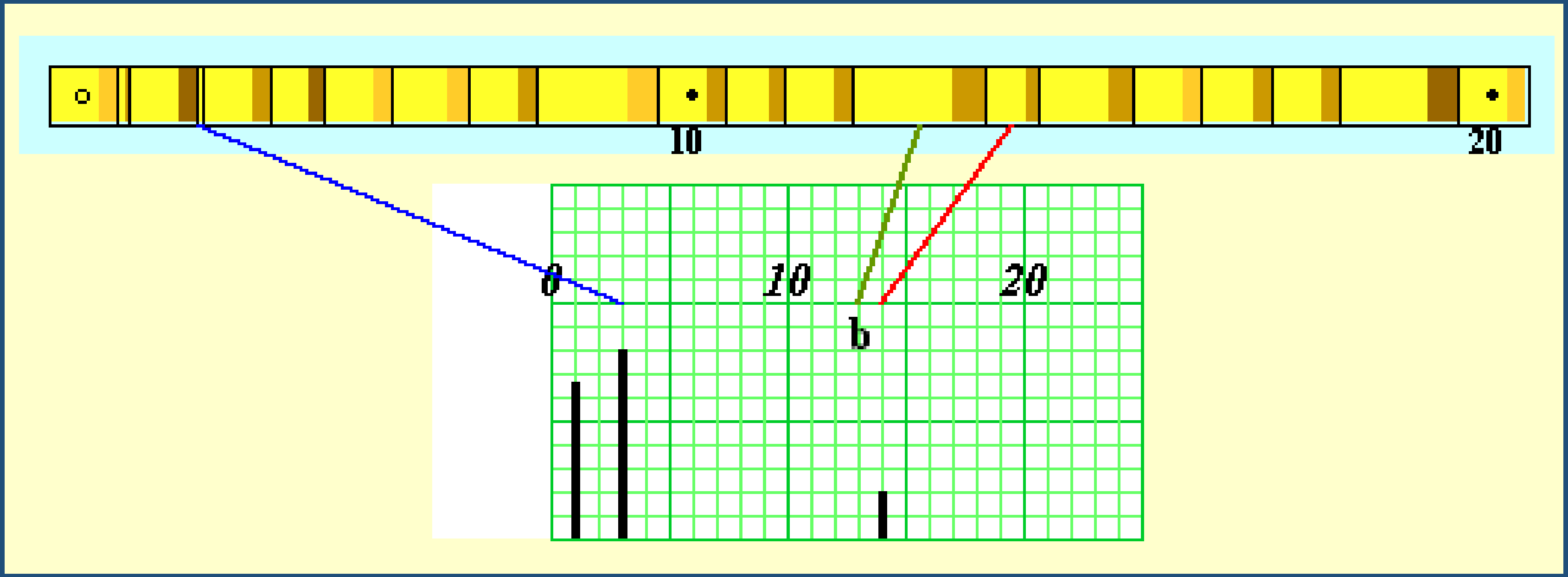
Variation in Ring Width Due to Environmental Conditions



Visual Inspection and Dot Dating



Skeleton Plots

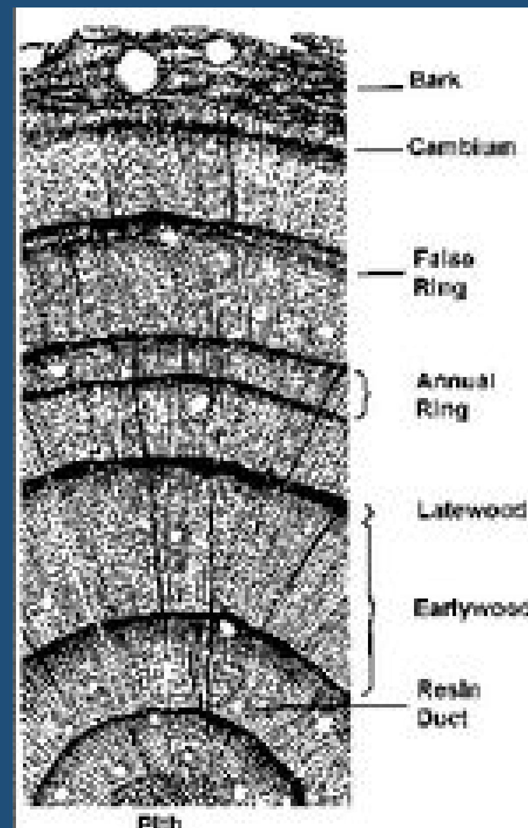


the narrower the ring, the longer the line!

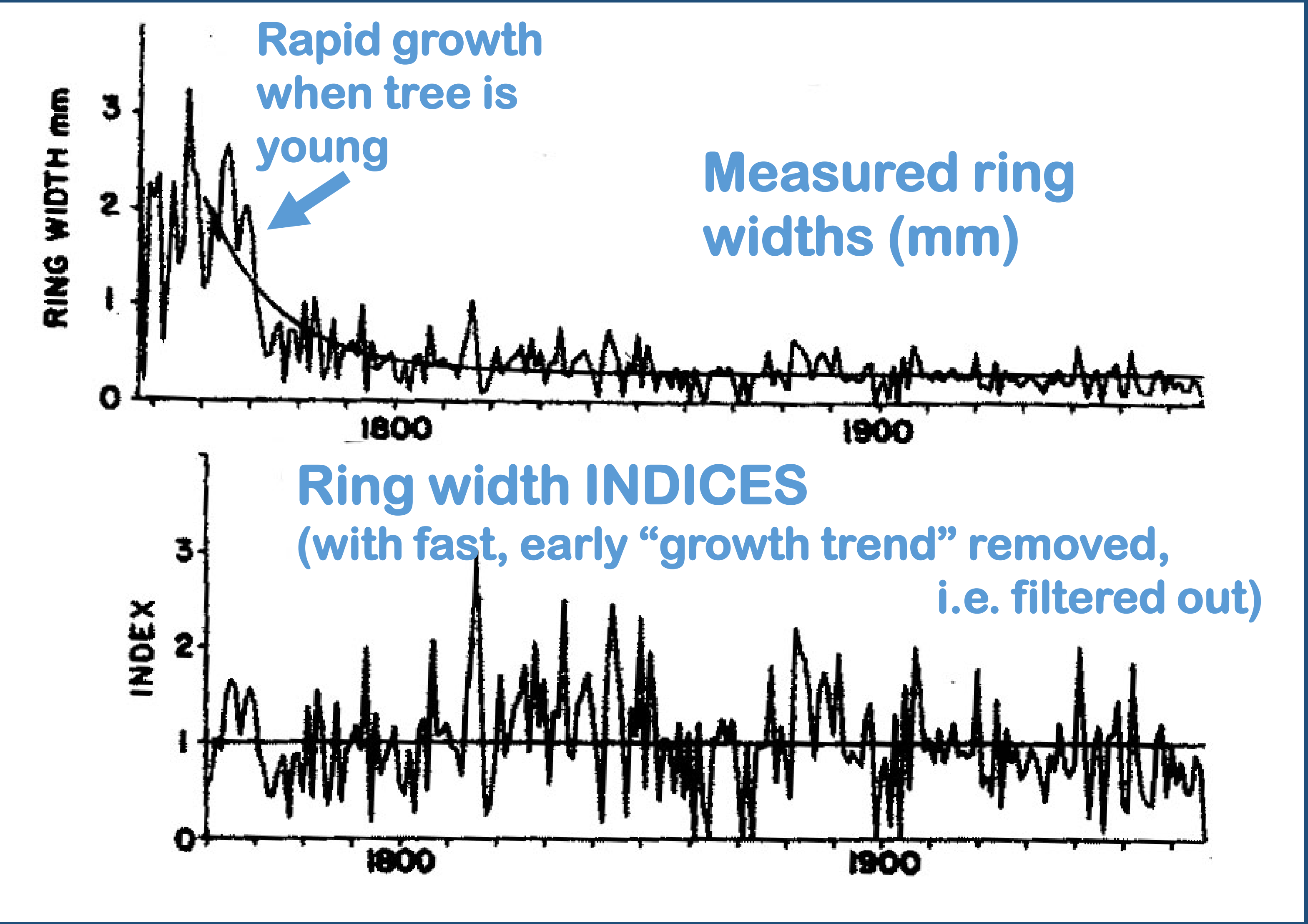
http://www.ltrr.arizona.edu/skeletonplot/plotting.htm

Measuring Rings (.001mm)

- False and Missing Rings



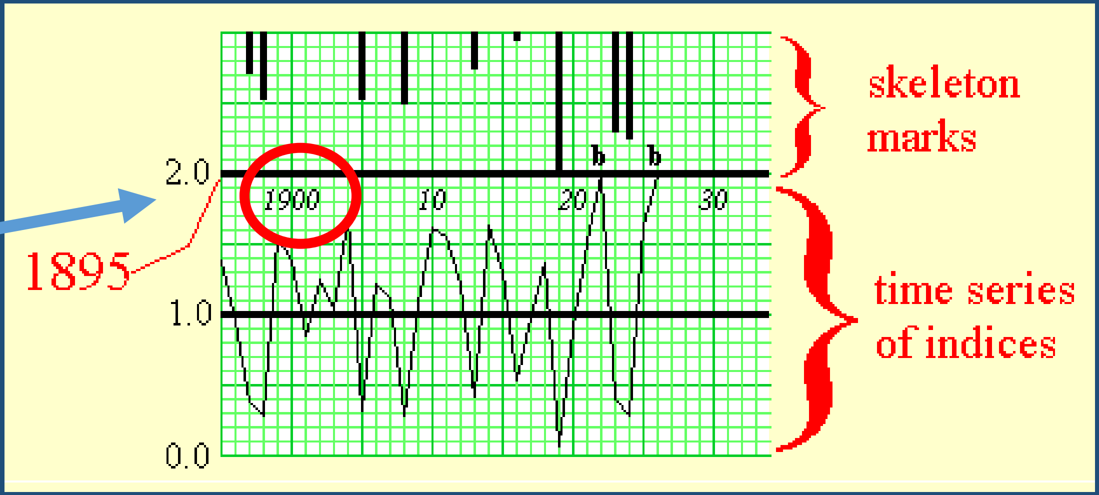
TREE-RING WIDTH



Introduction | Dendrochronology | Methods | Preliminary Results | Next Steps

The MASTER CHRONOLOGY is based on previously measured and dated tree rings from the same area and includes a master skeleton plot AND tree-ring width measurements (indices)

Actual calendar dates



Our Project

Study Site: St. Jones Reserve
Study Species: Eastern Red Cedar
(Juniperus virginia)

1. Master chronology 1
   (below 1 ft contour)
2. Master chronology 2
   (between 1 ft and 2 ft contour)
3. Difference chronology
4. Compare to tide gauge
5. Compare to storm records

Our Project

Study Site: St. Jones Reserve
Study Species: Eastern Red Cedar *(Juniperus virginia)*

1. Master chronology 1 (below 1ft contour)
2. Master chronology 2 (inundated with 1.0 m rise)
3. Difference chronology
4. Compare to tide gauge
5. Compare to storm records

Our Project

Study Site: St. Jones Reserve
Study Species: Eastern Red Cedar *(Juniperus virginia)*

1. Master chronology 1 (inundated with 0.5 m rise)
2. Master chronology 2 (between 1 ft and 2 ft contour)
3. Difference chronology
4. Compare to tide gauge
5. Compare to storm records

Our Project

Study Site: St. Jones Reserve
Study Species: Eastern Red Cedar
(Juniperus virginia)

1. Master chronology 1
   (inundated with 0.5 m rise)
2. Master chronology 2
   (between 1 ft and 2 ft contour)
3. Difference chronology
4. Compare to tide gauge
5. Compare to storm records

Our Project

Study Site: St. Jones Reserve
Study Species: Eastern Red Cedar *(Juniperus virginia)*

1. Master chronology 1
   (inundated with 0.5 m rise)
2. Master chronology 2
   (between 1 ft and 2 ft contour)
3. Difference chronology
4. Compare to tide gauge
5. Compare to storm records

Work Completed

- Collected duplicate cores from a minimum of 20 trees for both chronologies
- Glued and sanded all cores
- Dot dated and created a master skeleton plot for master chronology 1
- Measured all rings for master chronology 1
- In the quality control process for master chronology 1

Work Completed

- Collected duplicate cores from a minimum of 20 trees for both chronologies
- Glued and sanded all cores
- Dot dated and created a master skeleton plot for master chronology 1
- Measured all rings for master chronology 1
- In the quality control process for master chronology 1

Work Completed

- Collected duplicate cores from a minimum of 20 trees for both chronologies
- Glued and sanded all cores
- Dot dated and created a master skeleton plot for master chronology 1
- Measured all rings for master chronology 1
- In the quality control process for master chronology 1

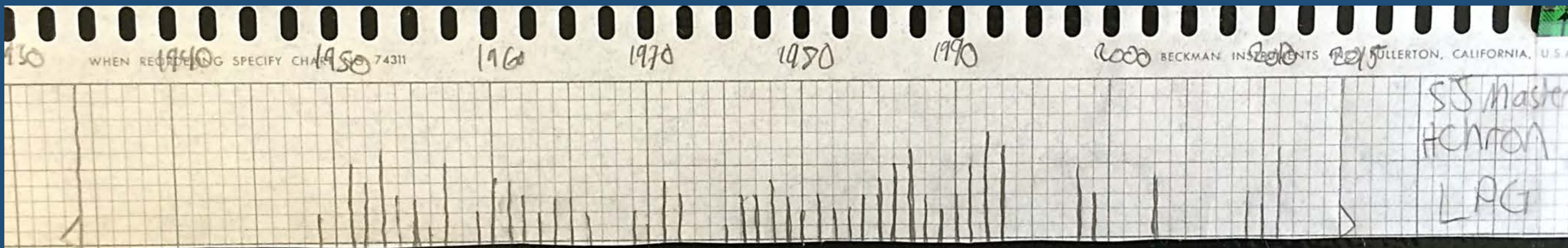
Work Completed

- Collected duplicate cores from a minimum of 20 trees for both chronologies
- Glued and sanded all cores
- Dot dated and created a master skeleton plot for master chronology 1
- Measured all rings for master chronology 1
- In the quality control process for master chronology 1

Work Completed

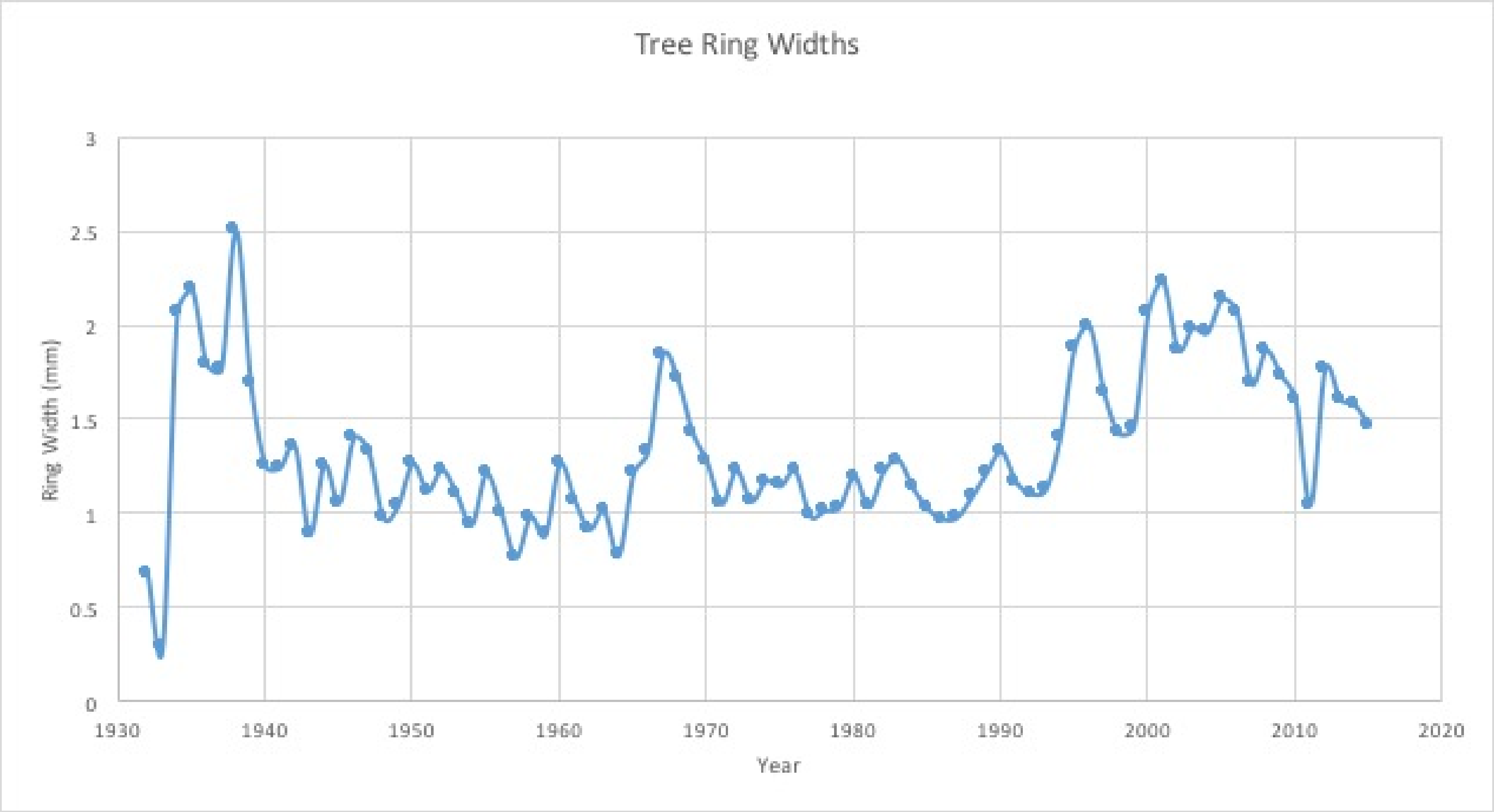
- Collected duplicate cores from a minimum of 20 trees for both chronologies
- Glued and sanded all cores
- Dot dated and created a master skeleton plot for master chronology 1
- Measured all rings for master chronology 1
- In the quality control process for master chronology 1

Preliminary Results



Time Span: 84 years (1932-2015)
Time Span with more than 2 series: 73 years (1943-2015)
Number of Series: 27
Rings measured: 1,175
Series intercorrelation 0.190
Average mean sensitivity .379
Problems to be addressed: 31

Preliminary Results



Next Steps

1. Clean up and de-trend master chronology 1
2. Build master chronology 2
3. Create difference chronology
4. Complete statistical analysis

References and Questions

Craft, C, Clough, J, Ehman, J, Joye, S, Park, R, Pennings, S, Guo, H, Machmuller, M. 2009. Forecasting the effects of accelerated sea-level rise on tidal marsh ecosystem services. Frontiers in Ecology and the Environment. 7 (73–78)

Noe, G., Krauss, K., Lockaby, B., Conner, W., Hupp, C. 2013. The effect of increasing salinity and forest mortality on soil nitrogen and phosphorous mineralization in tidal freshwater forested wetlands. Biogeochemistry. 114 (225-244).

Whigham, D, Baldwin, A, Barendregt, A. 2009. Tidal freshwater wetlands. In: Perillo, G, Wolanski, E, Cahoon, D, Brinson, M (eds). Coastal wetlands: an integrated ecosystem approach. Elsevier, Amsterdam. (515–534)